Aerospace
Conventional Power Generation
Manufacturing
Maritime
Nuclear Power Generation
Oil and Gas
Rail and Transport

VEQTER

Residual Stress Experts

VEQTER is an engineering company providing excellence in the measurement, analysis and management of residual stresses. We are world leaders in our field and offer expertise on any aspect related to residual stresses in engineering components and structures.

Ring Core technique

The Ring Core (RC) technique, also known as the Trepan technique, is a semi-destructive, mechanical strain release (MSR) technique used to measure near-surface stresses.

The technique involves cutting an annular groove into a component and the resulting surface strain relaxation within the central core is measured at predetermined depth increments using a strain gauge rosette (SGR) or optical methods. The surface strain relaxation is then decomposed into residual stresses for each depth increment using numerically determined influence coefficients (from Finite Element Analysis).

Typically, depths are limited to 5mm for a standard 14mm diameter core, but the use of different strain gauges and groove geometries will permit changes in total measurement depth. In the past the RC technique was mainly used to measure ‘uniform’ stress profiles to a depth of 5mm or less, however with recent advancements in analysis techniques and the development of a core removal procedure these depths have been extended to 25mm.

To find out how VEQTER can help you please contact us on +44 (0) 117 992 7970 or using experts@veqter.co.uk

VEQTER Ltd. **8 Unicorn Business Park, Whitby Road, Bristol BS4 4EX, UK**
e experts@veqter.co.uk t +44 (0) 117 992 7970 w www.veqter.co.uk

VEQTER

Residual Stress Experts

The bi-axial residual stresses measured (i.e. σxx, σyy and τxy) are an average of those acting across the cross-section of the central core. They can be calculated from the incremental strain measurements to provide either a single set of bi-axial results averaged over the total depth drilled or a variation in bi-axial residual stresses with depth drilled. The most commonly used analysis methods are the Incremental and Integral methods, with the Integral method providing the most accurate results.

Technique	Hole Diameter	Measurement Depth, Larger error
CHD Size 31	Ø1mm	0.5mm
CHD Size 62	Ø2mm	1mm
CHD Size 125	Ø4mm	2mm
Ring Core	**Ø14mm**	**5mm**

Measurement size compared with CHD.

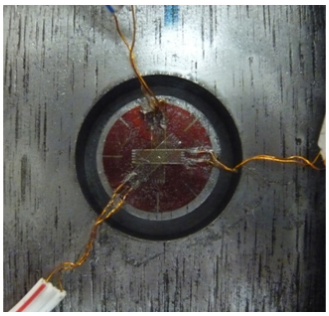
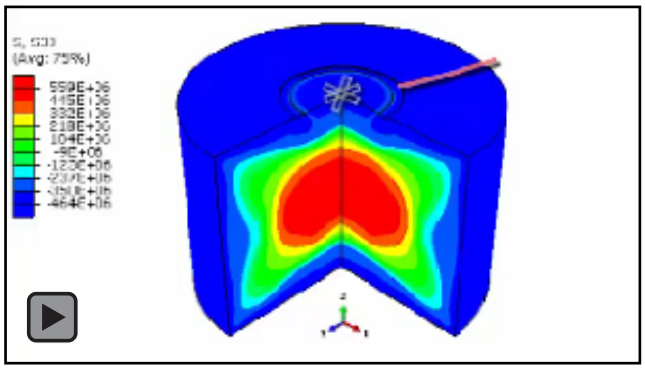


Photo of the SGR and central core after the RC technique

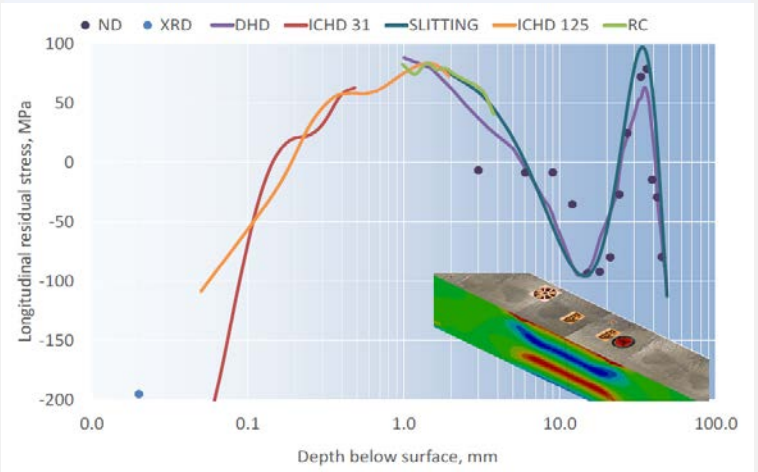


Finite element simulation of the Ring Core technique (sectional view)

Procedure of the ring core technique:

The basic experimental procedure is as follows:

1. Prepare (e.g. smooth and degrease) the component surface at the measurement location.
2. Glue the RC strain gauge rosette to the component and attach the lead wires.
3. Waterproof/encapsulate the SGR to ensure they are not damaged by the EDM fluid (not necessary for mechanical cutting).
4. Align the RC machine with the SGR. Thread the lead wires from the SGR through the electrode/cutter and connect to a strain gauge recorder.
5. Trepan the core in a series of increments.
6. Measure the hole depth and record the strain gauge readings for each increment trepanned.
7. After the process is complete make further measurements to check the cut depth and alignment to strain gauge, and make adjustments to the analysis procedure where appropriate.
8. Analyse the depth and strain gauge data to calculate the residual stress distribution.



Example results for a 50mm thick 4-point plastically bent beam.

Technique Specifications:

- Non-destructive technique;
- Laboratory or “on-site” measurements;
- Bi-axial (i.e. σxx and σyy) residual stress measurements;
- Applicable to a wide range of materials, both metallic and non-metallic.
- High magnitude residual stresses are measured accurately;
- Complex shapes can be measured providing rotation of the measuring head is not restricted;
- Nominal accuracy: 7MPa – Aluminium, 20MPa – Steel, 10MPa – Titanium;
- Very quick and easy to apply the process, and therefore cheap;
- Depth of measurement usually limited to 5mm, however up to 25mm can be measured with core removal, although is more difficult to apply and analyse
- Capable of accurately measuring high magnitude residual stresses within the first 5mm of depth measured;
- Not sensitive to eccentricity between the SGR and trepanned annulus;
- Strain gauges used are susceptible to noise and require surface preparation;
- Heavily reliant on good strain response curves.